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OBSERVATIONS ON *PLEUROBRANCHAEA*
CALIFORNICA MACFARLAND, 1966
(OPISTHOBRANCHIA, NOTASPIDEA)

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The large notaspidean opisthobranch *Pleurobranchaea californica* was described by MacFarland (1966). In October, 1964, two large specimens of this species were brought to Steinhart Aquarium, San Francisco, by Richard Poole of the California Department of Fish and Game. The larger individual measured 355 mm. in length by 125 mm. in width and was nearly twice the size of the other specimen. These notaspideans, taken from commercial crab pots set in waters of 30 to 40 fathoms near the southeast Farallon Island, were placed in a 55-gallon aquarium containing circulating refrigerated salt water (10-13°C.). Because the entire animal was not illustrated in connection with the original description of this species, it was felt desirable to provide a photograph of one of these fine specimens, as well as to record certain observations relating to them and to several other specimens (fig. 1).

Unfortunately, within 2 weeks of the time of capture the smaller individual had apparently disintegrated or had been eaten by the larger. Coan (1964) observed that this species is carnivorous and that its members will attack any animal offered, including those of its own species. The author has observed a large specimen of *P. californica* attack and almost completely devour a medium-sized anemone (*Anthopleura elegantissima*) in less than 10 minutes. The buccal armature and the extremely large radula would seem to lend themselves well to a predatory habit.

COLOR VARIATION

The over-all color of eight living specimens of *Pleurobranchaea californica* observed by the author showed little variation. These specimens were all taken in the vicinity of the Farallon Islands and Bodega Bay, California. The south-east Farallon Island individual (now faded) was quite typical of the northern color phase. The warty dorsal surface of the mantle was covered with a mottled

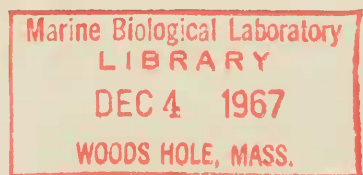




FIGURE 1. *Pleurobranchaea californica* MacFarland, 1966. Southeast Farallon Island, California, in 30-40 fathoms, 355 mm. in length.

pattern of brown pigment. Areas lacking pigment appeared as a series of rather large, irregular, translucent white patches. The dorsum of the foot and oral veil were lighter in color. An irregular network of fine wrinkles gave the entire dorsum a crepe-like appearance. A single living southern California specimen observed exhibited a much deeper shade of pigmentation, although the pattern was essentially the same (fig. 2).

EGG MASS AND VELIGERS

On 13 November, an egg mass was noted attached to a stone in the aquarium (fig. 3). The entire mass had been laid the previous night. Subsequently, the remaining large animal and its egg mass were placed in a 30-gallon tank and photographed. The veligers began to hatch from the gelatinous matrix of the egg ribbon 22 November, and by the next day the ribbon had disintegrated. At the time of hatching, alternating rows of egg capsules were observed within the egg ribbon, and each capsule contained many active veligers. The number of veligers per capsule appeared to range from 10 to 15 (fig. 4). The free-swimming larvae were so numerous on the morning of 23 November that the water in the tank became quite murky. Samples of the veligers were taken over a period of 2 days, until living individuals could no longer be found in the

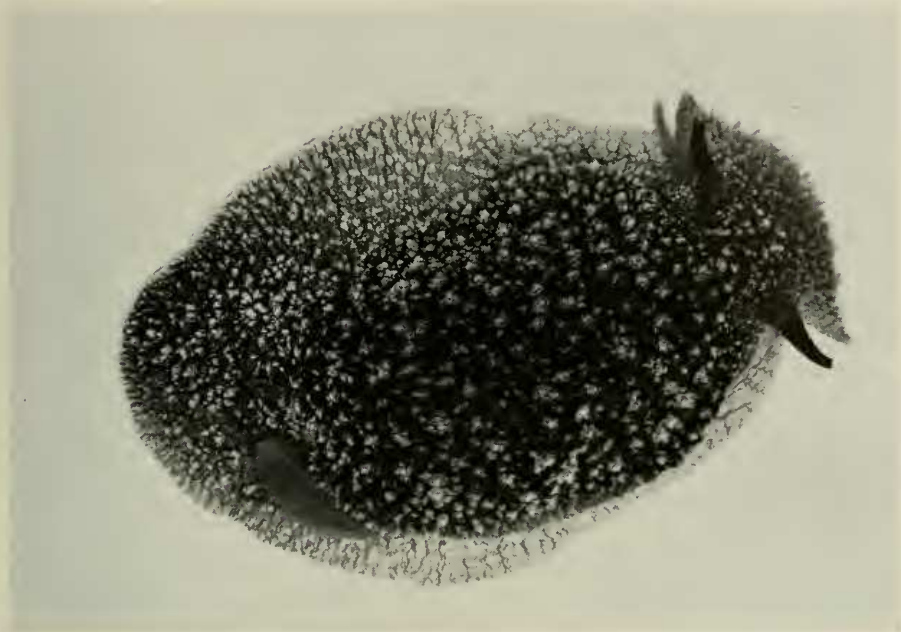


FIGURE 2. *Pleurobranchaea californica* MacFarland, 1966. Santa Cruz Island, California, in 30-60 feet, 145 mm. in length, showing the gill on the right side.

aquarium. Upon hatching, the tiny shells measured 150μ and consisted of one and one-half whorls.

NARCOTIZATION

Considerable difficulty was encountered in the narcotization of the large adult of *P. californica*. On 27 November the specimen was placed in a solution of magnesium chloride and sea water. Five hundred ml. of 7 percent magnesium chloride solution were added to 8 liters of sea water and placed under refrigeration at approximately $+5^{\circ}\text{C}$. After 7 hours the animal appeared to be unaffected, except for the production of large quantities of viscous mucus. That this mucus may have defensive qualities for the organism is suggested by the report of Paine (1963) who found that the mucus secretions of an individual belonging to *Pleurobranchaea* sp. (in all probability *P. californica*) collected in southern California waters, had a pH of 1.0. The morning of 28 November the magnesium chloride appeared to have had no narcotizing effect; therefore, 10 gms. of chloral hydrate crystals were added and the temperature reduced to approximately -1°C . Twenty-four hours later the animal still actively responded to touch by retracting its rhinophores and oral veil. An additional 10 gms. of chloral hydrate was added at this time.



FIGURE 3. Egg ribbon of Farallon Island specimen shown in figure 1. Length about 6 inches.

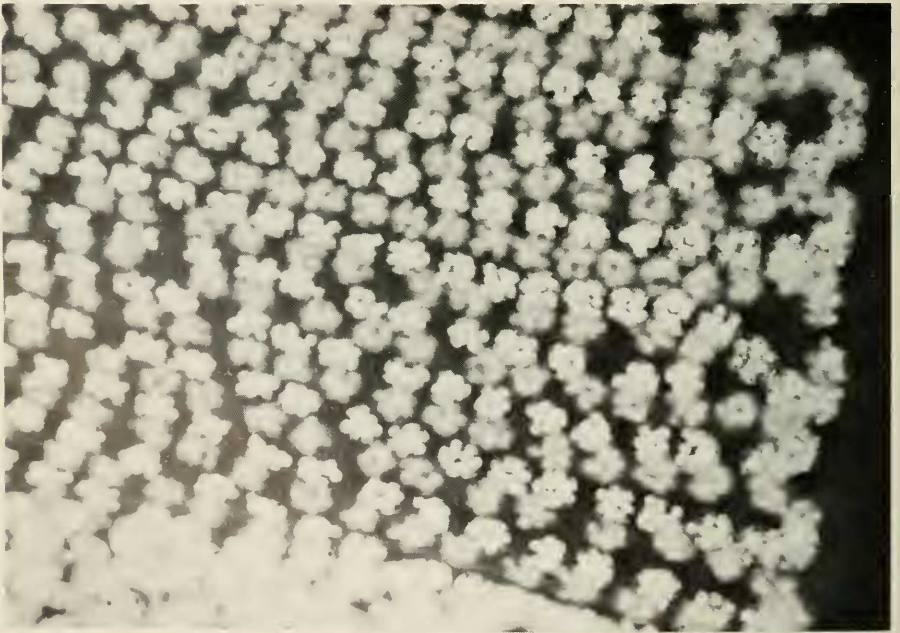


FIGURE 4. Egg capsules with unhatched veligers of Farallon Island specimen.

On 30 November, there was no change in the specimen's ability to respond to mechanical stimulation. Consequently, 70 percent ethyl alcohol was slowly added, 15 ml. at a time over a 4 day period. By 4 December, 270 ml. of 70 percent ethyl alcohol had been added and although the solution had become quite murky, the opisthobranch retracted its rhinophores and oral veil when prodded. The solution was maintained at this concentration until mechanical stimulation failed to cause visible contraction of any part of its external anatomy. On 7 December, 11 days after the beginning of the narcotizing process, the animal failed to respond.

GEOGRAPHIC DISTRIBUTION

Acquisition of this fine specimen of *Pleurobranchaea californica* brings the total number of specimens of this species contained in the Academy's preserved invertebrate collection to 39. The over-all length of individuals ranges from 165 mm. down to 8 mm. The geographic range of the Academy's specimens is from lat. $41^{\circ}27'N.$; long. $124^{\circ}29'W.$ to lat. $32^{\circ}43'N.$; long. $117^{\circ}14'W.$, or approximately from off the mouth of the Klamath River to San Diego, California. All specimens which carried data regarding bottom conditions were found on a substrate consisting predominantly of fine "green mud." The bathymetric range of our specimens is from 30–60 feet to approximately 200 fathoms.

Following is a list of the 20 specimen lots of *P. californica* contained in the collection of the California Academy of Sciences, Department of Invertebrate Zoology. All are from the California coast:

- LOT NO. 1, 115–119 fms., WSW. of the mouth of the Klamath River, lat. $41^{\circ}27'N.$, long. $124^{\circ}29'W.$, Peter Isaacson, collector, 10 September 1964. Single specimen.
- LOT NO. 2, 70–74 fms. off Bodega Bay, California Fish and Game Block no. 249. Phil Hanson and Dan Clark, collectors. May, 1949. Single specimen.
- LOT NO. 3, 68 fms., fine green sand, Farallon Light, N. $11\frac{1}{2}^{\circ}$ East, 3.8 miles. United States Fish Commission Steamer *Albatross*, collector. Station no. D-5788, 21 October 1912. Two specimens. Syntypes.
- LOT NO. 4, 46 fms., fine green sand, Farallon Light, N. $42\frac{1}{2}^{\circ}W.$, 3.9 miles. United States Fish Commission Steamer *Albatross*, collector. Station no. D-5789, 21 October 1912. Single specimen.
- LOT NO. 5, 60 fms., Farallon Light, 4 miles, $10^{\circ}W.$ California Department of Fish and Game R/V. *N. B. Scofield*, collector, 21 April 1948. Single specimen.
- LOT NO. 6, 60–80 fms. Farallon Islands, area of the southeast Farallon. Richard Poole, California Department of Fish and Game, collector. Taken in commercial crab pot. October, 1964. Single specimen.
- LOT NO. 7, 15–20 fms. off Ocean Beach, San Francisco, near Fleishhacker Pool. Dennis Sullivan, collector, 7 December 1962. Single specimen.

- LOT NO. 8, 100 fms. off Davenport, Santa Cruz County. Captain C. Davies of the drag boat *Warrior*, collector. June, 1962. Single specimen.
- LOT NO. 9, 76 fms. Dark green mud and sand, off of Santa Cruz light, Monterey Bay. N. 31° W., 6.1 miles. United States Fish Commission Steamer, *Albatross*, collector, 12 May 1904. Station no. D-4480. Single specimen.
- LOT NO. 10, 37 fms. On dark green mud, fine sand, black specks. Off Monterey, Point Pinos Light House. Six miles S. 35° W. United States Fish Commission Steamer *Albatross*, collector. Station no. D-4458, 12 May 1904. Single specimen.
- LOT NO. 11, 92 fms. Off Avila, San Luis Obispo County. Ten miles, 348° True SW. of Avila. G D. Hanna, collector, 25 February 1951. Two specimens.
- LOT NO. 12, 30-60 ft. Off Santa Cruz Island. Dr. James Case, collector. Taken with SCUBA. Single specimen. Figure 2.
- LOT NO. 13, 80-92 fms. Off Santa Barbara. Ten miles, 65° True. G D. Hanna, collector, 19 February 1951. Single specimen.
- LOT NO. 14, About 200 fms., green mud, 198° True from Point Fermin, 8.5 miles. Crocker-Stanford 1938 Deep Sea Expedition. G. S. Myers, R. L. Bolin *et al.*, collectors. Station no. 28, 17 September 1938. Thirteen specimens all less than 25 mm. in length.
- LOT NO. 15, 440-470 meters. Off San Pedro, lat. $33^{\circ}38'$ to $33^{\circ}41'N.$; long. $118^{\circ}17.6'$ to $118^{\circ}19.5'W.$ W. E. Ritter and W. J. Raymond, collectors. San Diego Marine Biological Association. Station no. XIV-H2, 13 June 1901. Single specimen less than 25 mm. long.
- LOT NO. 16, 60 fms. Santa Catalina Island. One and three-quarters miles, 105° True from Long Point. Lat. $33^{\circ}22'N.$; long. $118^{\circ}20'W.$ Crocker-Stanford 1938 Deep Sea Expedition. G. S. Myers, R. L. Bolin *et al.*, collectors. Station no. 47, 20 September 1938. Three specimens, one less than 25 mm. long.
- LOT NO. 17, 178 fms. On fine gray sand and rock off Santa Catalina Island. N. 79° W., 2.8 miles off Long Point. United States Fish Commission Steamer *Albatross*, collector. Station no. D-4410, 11 April 1904. Single specimen.
- LOT NO. 18, 80 fms. On dead and bleached corallines. Santa Catalina Island. $33^{\circ}23'N.$, $118^{\circ}20'W.$, off Avalon. Crocker-Stanford 1938 Deep Sea Expedition. G. S. Myers, R. L. Bolin *et al.*, collectors. Station no. 30, 17 September 1938. Two specimens.
- LOT NO. 19, 110 fms. Green mud and shale, off La Jolla, 3.2 miles S. 34° E. from Soledad Hill Point. United States Fish Commission Steamer *Albatross*, collector. Station no. D-4322, 7 March 1904. Two specimens.
- LOT NO. 20, 35-38 fms. Green mud and sand. Off Point Loma. M. W. Williams and K. W. Kenyon, collectors, 9 October 1946. Two specimens under 25 mm. long.

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